

What is claimed is:

1. A semiconductor device, comprising:

a plurality of first elements formed in a first region of a semiconductor substrate;

5 a first trench formed between said first elements in said first region;

a first element-isolating film including an insulating material which fills said first trench;

10 a plurality of second elements which are formed in a second region of said semiconductor substrate and to which a voltage higher than that of said first element is supplied;

a second trench formed between said second elements in said second region; and

15 a second element-isolating film including an insulating material which fills said second trench,

wherein a curvature of an interface between a top edge portion of said second element-isolating film and said semiconductor substrate is larger than  
20 a curvature of an interface between a top edge portion of said first element-insulating film and said semiconductor substrate.

2. The semiconductor device according to claim 1, wherein said second element is a memory cell of a nonvolatile semiconductor memory.  
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3. The semiconductor device according to claim 1, wherein said first element is a MOS transistor.



4. A method of fabricating a semiconductor device, comprising the steps of:

forming a plurality of first trenches in a first region of a semiconductor substrate and a plurality of second trenches in a second region of said semiconductor substrate;

increasing a curvature of a top edge portion of said second trench;

filling said first and second trenches with an insulating material; and

forming a first element in said first region and a second element in said second region, a voltage higher than that of said first element being supplied to said second element.

5. The method of fabricating a semiconductor device according to claim 4, wherein said first element is a MOS transistor and said second element is a memory cell of a nonvolatile semiconductor memory.

6. A method of fabricating a semiconductor device, comprising the steps of:

forming a first insulating film in first and second regions of a semiconductor substrate;

forming, on said first insulating film, a second insulating film formed of a material different from that of said first insulating film;

patterning said second insulating film;



etching said first insulating film and said semiconductor substrate by use of said second insulating film as a mask, forming a first trench in said first region of said semiconductor substrate, and forming a second trench in said second region of said semiconductor substrate;

side-etching only said first insulating film of said second region;

oxidizing inner surfaces of said first trench and second trench;

forming a first element-isolating film and a second element-isolating film by filling said first and second trenches with an insulating material; and removing said second insulating film.

7. The method of fabricating a semiconductor device according to claim 6, wherein said first insulating film is formed of silicon oxide and said second insulating film is formed of silicon nitride.

8. The method of fabricating a semiconductor device according to claim 6, further comprising, after the step of removing said second insulating film, the steps of:

removing said first insulating film in said first and second regions; and

forming a third insulating film between said first trenches in said first region and a fourth insulating film between said second trenches in said



second region.

9. The method of fabricating a semiconductor device according to claim 8, further comprising the step of forming a MOS transistor in said first region and a memory cell in said second region. 6

10. A method of fabricating a semiconductor device, comprising the steps of:

forming a first insulating film in a first region of a semiconductor substrate and a second insulating film in a second region, said second insulating film being formed of the same insulating material as said first insulating film, said second insulating film having a film thickness larger than that of said first insulating film;

15 forming, on said first and second insulating films, a third insulating film formed of an insulating material different from those of said first and second insulating films;

patterning said third insulating film;

20 etching said first and second insulating films and said semiconductor substrate by use of said third insulating film as a mask, and forming a first trench in said first region and a second trench in said second region;

25 oxidizing inner surfaces of said first and second trenches;

forming a first element-isolating film and a



second element-isolating film by filling said first and second trenches with an insulating material; and removing said second insulating film.

11. The method of fabricating a semiconductor device according to claim 10, wherein said first and second insulating films are formed of silicon oxide, and said third insulating film is formed of silicon nitride.

12. The method of fabricating a semiconductor device according to claim 10, further comprising the step of forming a MOS transistor in said first region and a memory cell in said second region.

13. A method of fabricating a semiconductor device, comprising the steps of:

forming a first insulating film in a first region of a semiconductor substrate and a second region of said semiconductor substrate;

forming, on said first insulating film, a second insulating film formed of an insulating material different from that of said first insulating film;

forming a resist film on said second insulating film and patterning the resist film of said second region;

etching said second insulating film, said first insulating film and said semiconductor substrate in said second region by use of said resist film as a



mask, and forming a first trench having a width smaller than that of an opening of said resist film;

removing said resist film;

5       patterning said second insulating film in said first region;

      etching said first insulating film and said semiconductor substrate by use of said second insulating film in said first region as a mask, and forming a second trench having the same width as  
10       that of the opening of said second insulating film in said first region;

      oxidizing inner surfaces of said first and second trenches;

      forming a first element-isolating film and a  
15       second element-isolating film by filling said first and second trenches with an insulating material; and removing said second insulating film.

14. The method of fabricating a semiconductor device according to claim 13, wherein said first  
20       insulating film is formed of silicon oxide, and said second insulating film is formed of silicon nitride.

15. The method of fabricating a semiconductor device according to claim 13, further comprising the step of forming a MOS transistor in said first  
25       region and a memory cell in said second region.

16. A method of fabricating a semiconductor device,  $\mu$  comprising the steps of:



forming a first insulating film in a first region of a semiconductor substrate and a second insulating film in a second region of said semiconductor substrate, said second insulating film being formed of the same insulating material as said first insulating film, said second insulating film having a film thickness larger than that of said first insulating film;

forming a semiconductor film on said first and second insulating films;

forming, on said semiconductor film, a third insulating film formed of an insulating material different from that of said first and second insulating films;

patterning said third insulating film;

etching said semiconductor film, said first and second insulating films and said semiconductor substrate by use of said third insulating film as a mask, forming a first trench in said first region and forming a second trench in said second region;

oxidizing inner surfaces of said first and second trenches; and

forming a first element-isolating film and a second element-isolating film by filling said first and second trenches with an insulating material.

17. The method of fabricating a semiconductor device according to claim 16, wherein said first and



second insulating films are formed of silicon oxide, and said third insulating film is formed of silicon nitride.

18. The method of fabricating a semiconductor device according to claim 16, further comprising the step of forming a MOS transistor in said first region and a memory cell in said second region.

19. The method of fabricating a semiconductor device according to claim 18, further comprising the step of forming a gate electrode of at least one of said MOS transistor and said memory cell by use of said semiconductor film.

20. A method of fabricating a semiconductor device, comprising the steps of:

forming a first insulating film in a first region of a semiconductor substrate and in a second region of the semiconductor substrate;

forming, on said first insulating film, a second insulating film formed of an insulating material different from that of said first insulating film;

forming a first trench by etching the second insulating film, said first insulating film and said semiconductor substrate in said second region;

forming a gap between a top edge portion of said first trench and said first insulating film by performing heat treatment in a hydrogen atmosphere;



forming a second trench by etching said second insulating film, said first insulating film and said semiconductor substrate in said first region;

5 oxidizing inner surfaces of said first and second trenches;

forming a first element-isolating film and a second element-isolating film by filling said first and second trenches with an insulating material; and

removing said second insulating film.

10 21. The method of fabricating a semiconductor device according to claim 20, wherein said first insulating film is formed of silicon oxide, and said second insulating film is formed of silicon nitride.

15 22. The method of fabricating a semiconductor device according to claim 20, further comprising the step of forming a MOS transistor in said first region and a memory cell in said second region.

23. A method of fabricating a semiconductor device, comprising the steps of:

20 forming a first insulating film in a first region of a semiconductor substrate and in a second region of the semiconductor substrate;

forming, on said first insulating film, a second insulating film formed of an insulating material different from that of said first insulating film;

forming a first trench by etching said second



insulating film, said first insulating film and said semiconductor substrate in said second region;

oxidizing a surface of said first trench;

forming a second trench by etching said second insulating film, said first insulating film and said semiconductor substrate in said first region;

making, by oxidizing a surface of said second trench and further oxidizing a surface of said first trench, a curvature of an interface between a top edge portion of said first trench and said semiconductor substrate being larger than a curvature of an interface between a top edge portion of said second trench and said semiconductor substrate;

forming a first element-isolating film and a second element-isolating film by filling said first and second trenches with an insulating material; and

removing said second insulating film.

24. The method of fabricating a semiconductor device according to claim 23, wherein said first insulating film is formed of silicon oxide, and said second insulating film is formed of silicon nitride.

25. The method of fabricating a semiconductor device according to claim 23, further comprising the step of forming a MOS transistor in said first region and a memory cell in said second region.

26. A semiconductor device, comprising:



a semiconductor substrate;

a shallow trench including a trench being formed in said semiconductor substrate and an insulator being embedded in the trench, said shallow trench isolating said semiconductor substrate to form a plurality of element regions;

a gate-insulating film formed on said element region of said semiconductor substrate; and

a gate electrode formed on said gate-insulating film;

wherein a curved surface is formed in an edge portion of said element region in a cross section of said semiconductor substrate by performing oxidation with a volume of oxygen being supplied to the edge portion kept larger than a volume of oxygen being supplied to a central portion.

27. The semiconductor device according to claim 26, wherein said curved surface in the edge portion of said element region is formed by performing oxidation with only the edge portion of said element region kept exposed.

28. The semiconductor device according to claim 26, wherein said curved surface in the edge portion of said element region is formed by preferentially oxidizing the edge portion of said element region by use of oxygen supplied through an oxide film thicker than said gate-insulating film.